

**Transmission and Multiplexing (TM);
Passive optical components;
Fibre optic patchcords for
single mode optical fibre communication systems;
Common requirements and conformance testing**



Reference

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

1 Scope

The present document is an ETSI standard on optical patchcords with connectors for use as patchcords within optical transmission systems. The optical fibres are those described in EN 188100 [9] (sectional specification) and EN 188101 [10] (family specification). The considered patchcords use the cables with either primary and secondary coating and diameter of 0,9 mm or primary, secondary and outer coating and diameter up to 3,5 mm.

The present document specifies requirements of cables assemblies with connector sets to be used in single-mode optical fibre telecommunication systems. The scope covers the establishment of minimum uniform requirements for the following aspects:

- optical, environmental and mechanical properties;
- test conditions;
- acceptance criteria.

Some users may have additional specific requirements, such as a need to verify performance at lower temperatures. These users should specify patchcords with connectors conforming to the basic ETSI performance standard, plus additional tests or more severe test conditions.

Patchcords for different applications which fall within the scope of the present document have common environmental and mechanical stability requirements.

Patchcords specified according to this specification shall be assembled with connector sets already approved by I-ETS 300 671 [7].

Patchcords specified according to this specification shall also be assembled with single fibre cables already approved by I-ETS 300 644 [8]. The outer diameter of the single fibre cable shall be up to 3,5 mm.

Test methods are in accordance with EN 186000-1 [1] or IEC 61300 [3] series [3].

For a definition of a patchcord with connector see clause 3 of the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] EN 186000-1 (1993): "Generic Specification: Connector sets for optical fibres and cables; Part 1: Requirements, test methods and qualification approval procedures".
- [2] EN 186005 (1993): "Blank Detail Specification: Connectors for optical fibres and cables; Environmental category V".
- [3] IEC 61300-X-X (X-X = different sub-parts): "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures".
- [4] ETSI ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

- [5] IEC 60695-2-2 (1991-05): "Fire hazard testing - Part 2: Test methods - Section 2: Needle-flame test".
- [6] IEC 60794-1-2 (1999-03): "Optical fibre cables - Part 1: Generic specification - Section 2: Basic optical cable test procedures".
- [7] ETSI I-ETS 300 671: "Transmission and Multiplexing (TM); Passive optical components; Fibre optical connectors for single-mode optical fibre communication systems; Common requirements and conformance testing".
- [8] ETSI I-ETS 300 644: "Transmission and Multiplexing (TM); Optical fibre cables for indoor applications".
- [9] EN 188100: "Sectional Specification: Single-mode (SM) optical fibre".
- [10] EN 188101: "Family Specification: Single-mode dispersion unshifted (B1.1) optical fibre".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

connector set: complete set of connector components required to provide demountable coupling between one or more pairs of optical fibres

patchcord: single fibre cable with the length more than 2 m and less than 20 m terminated with connectors on each end

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

OTDR	Optical Time Domain Reflectometer
SM	Single Mode
RL	Return Loss

4 Details, measurements and performance requirements

The tests required to prove the performance of connectors for applications covered by the present document are based on those in table 1 of EN 186005 [2]. There are, however, several significant differences and these are listed below.

All measurements shall be carried out under normal room conditions, unless otherwise stated. Before the insertion and return loss measurement, careful cleaning in accordance with manufacturers instructions is necessary.

All optical tests shall be carried out in both the 1 310 nm window and the 1 550 nm window unless otherwise stated. Light sources with peak wavelengths of $1\ 310 \pm 30$ nm and $1\ 550 \pm 30$ nm shall be used.

4.1 Attenuation

NOTE: Attenuation is referred to as "insertion loss" in EN 186000-1 [1] and EN 186005 [2]. The two terms are interchangeable and "attenuation" is used in the present document.

4.1.1 Attenuation against a reference connector

Details:

In accordance with EN 186000-1 [1], subclause 4.4.7, method 7 (measurements against a reference plug).

Reference plug:

- Type A): For qualification testing to determine the loss of connector sets when one side is a defined reference, the eccentricity of the reference connector plug (centre of fibre core to centre of ferrule) shall be $\leq 0,3 \mu\text{m}$. The reference plug shall in all other respects conform to the same detail or product specification as the connector under test.
- Type B): For environmental, mechanical and climatic testing detailed in the present document, the reference plug shall be selected randomly from the regular production of the connector sets that are undergoing qualification testing. For these tests, the initial loss of the connector sets that are to be tested shall be less than 1,00 dB for plugs conforming to grade P or less than 0,60 dB for plugs conforming to grade Q.

Only the fundamental mode shall propagate at the connector interface and at the detector.

Requirements:

Attenuation: $\leq 0,50$ dB when mated to reference plug Type A. (This is the maximum for any mating).

4.1.2 Attenuation of random mated connectors

Details:

In accordance with IEC 61300-3-34 [3].

Only the fundamental mode shall propagate at the connector interface and at the detector.

Statistical attenuation requirements:

- attenuation grade P: Mean $\leq 0,35$ dB;
1,00 dB maximum for ≥ 97 % of mating combinations.
- attenuation grade Q: Mean $\leq 0,30$ dB;
0,60 dB maximum for ≥ 99 % of mating combinations.

4.2 Return Loss (RL) of random mated connectors

Details:

In accordance with EN 186000-1 [1] subclause 4.4.12, method 2 (coupler method):

- launch fibre length (L): $2\text{m} \leq L \leq 4 \text{m}$;
- source stability: better than $\pm 0,20$ dB over the measurement period.

Alternatively, the return loss may be measured using an Optical Time Domain Reflectometer (OTDR) in accordance with IEC 61300-3-6 [3] method 2. If this method is used the OTDR pulse length shall be selected to give return loss measurements equivalent to those which would be given by the coupler based technique.

- Reference connector: the reference connector shall conform to the same detail or product specification as the connector under test.

Requirements:

RL (minimum return loss for every mating):

RL grade T: ≥ 35 dB for low-reflection connectors (as measured when mated);

RL grade U: ≥ 45 dB for ultra low-reflection connectors (as measured when mated);

RL grade V: ≥ 55 dB for ultra-low reflection connectors (as measured when mated and unmated).

4.3 Visual inspection

Details:

In accordance with IEC 61300-3-1 [3].

Method:

The specimen are of the proper delivery according to sample size and component as well as cable type.

Each patchcord shall be properly packed. The package shall be marked with the name of the manufacturer and the production date.

The patchcord itself shall be legibly and durably marked on both ends with the identity mark of the manufacturer and the manufacturing date code.

4.4 Flammability

Details:

In accordance with IEC 60695-2-2 [5].

Duration of application: 10 s;

Tissue paper position: 200 ± 5 mm below the place where the flame is applied.

Requirements:

Materials: low smoke zero halogen materials shall be applied;

Duration of burning: 5 s after the test flame is removed;

Tissue paper: no ignition by burning or glowing particles.

4.5 Cable bend

Details:

In accordance with IEC 60794-1-2 [6].

mandrel diameter: 60 mm;

endurance duration per revolution: 5 s;

number of revolutions: depending on length of patchcord;

Length of patchcord L	Total number of turns n
2	4
3	10
5	18
10	40

cycle: wrapping and unwrapping;
 number of cycles: 3.

NOTE: Cable bend test should be applied before and after the change of temperature test.

Requirements:

allowable attenuation variation: $\leq 0,20$ dB, measured at $1\ 550 \pm 30$ nm;
 allowable return loss variation: return loss shall not fall below the minimum for the grade.

4.6 Change of temperature

In accordance with EN 61300-2-22 [3].

Details:

length of the patchcord 4,5 m \pm 0,5 m
 high temperature: +70°C;
 low temperature: -25°C;
 duration at extreme temperatures: 1 hour;
 number of cycles: 12;
 rate of temperature change: 1°C/minute;
 preconditioning procedure: standard atmospheric conditions for 2 hours;
 recovery procedure: allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements:

allowable attenuation variation: $\leq 0,40$ dB, measured at $1\ 550 \pm 30$ nm;
 allowable return loss variation: return loss shall not fall below the minimum for the grade.

NOTE 1: Maximum time interval between measurements during the test 15 minutes.

NOTE 2: Whole patchcord with both connectors within the climatic chamber.

5 Qualification for ETS 300 019 environment classes 3.3, 3.4, 3.5 and 4.1

The following four tests shall be carried out on patchcords which are to be used in weather protected environments corresponding to **ETS 300 019** [4] classes 3.3, 3.4, 3.5 or non-weather protected environments class 4.1.

Visual Inspection 10 specimens;
 Flammability 2 specimens;
 Cable Bend 8 specimens;
 Change of Temperature 8 specimens.

6 Pass/fail criteria

To satisfy the qualification approval requirements of the present document performance specification there shall be no failures of any in the sample groups for any test parameter. If a failure does occur this shall be investigated and the cause of failure identified and corrected. The test which is affected shall then be repeated using the minimum sample size stated in the present document.

A fully documented test report and supporting data shall be prepared and shall be available for inspection. Failures and the corrective action taken to eliminate failures shall be documented and evidence must be presented to show that the corrective action will have no detrimental effect on the performance in any of the other tests. Design changes, as opposed to improvements in quality control, will usually be deemed to necessitate a repeat of the full qualification programme.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

IEC 61313-1: "Fibre optic passive components and cable assemblies - Part 1: Capability approval - Generic specification".

IEC 60874-1: "Amendment 1 (1994): "Connectors for optical fibres and cables; Part 1: Generic specification".

History

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